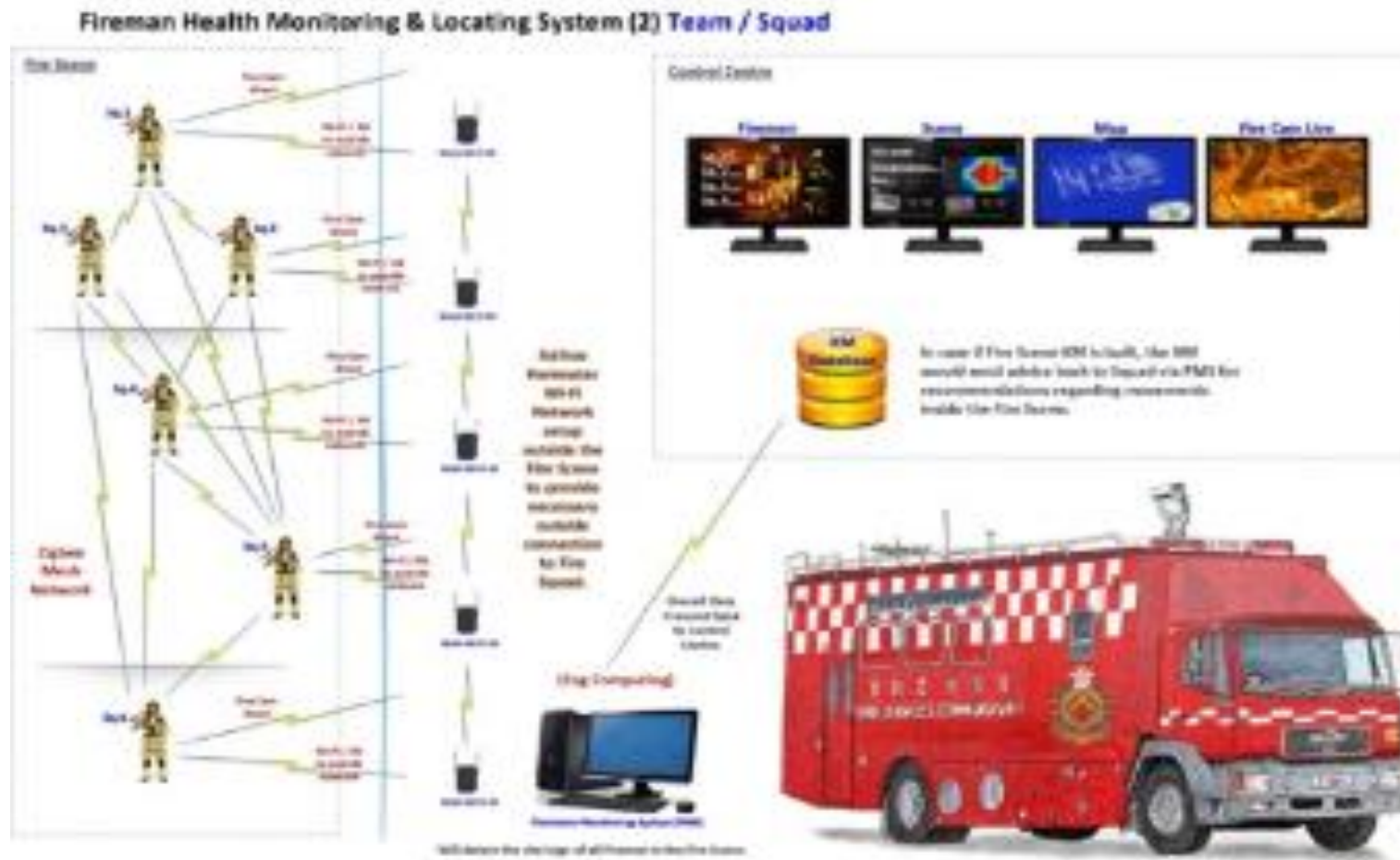# FIREMAN'S HEALTH & LOCATION TRACKING SYSTEM

JES LINK INNOVATION LIMITED

FIREMAN HEALTH MONITORING & LOCATING SYSTEM

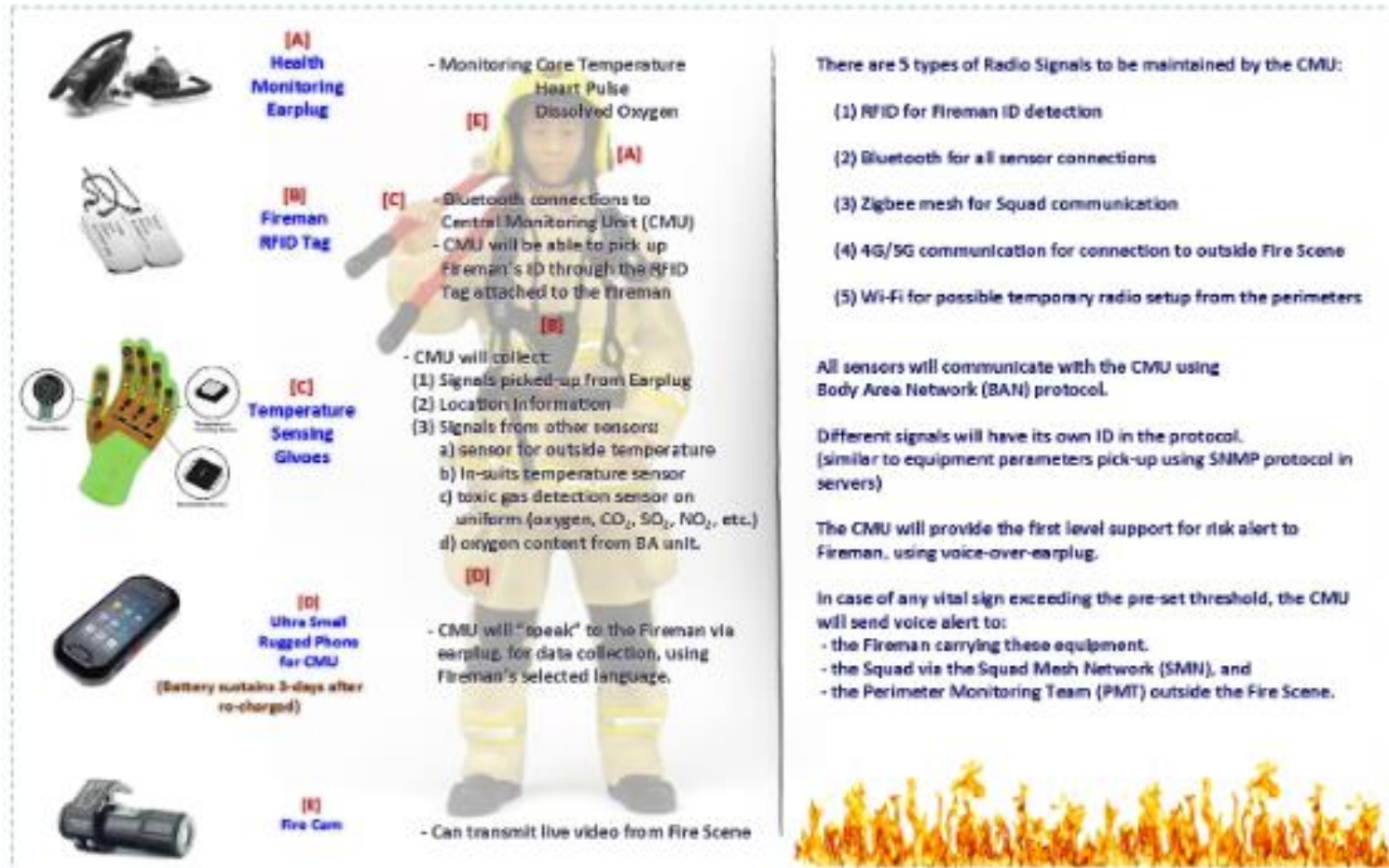# CUSTOMER REQUIREMENTS
FIREMAN HEALTH MONITORING & LOCATING SYSTEM

Fireman Health Monitoring & Locating System (1) Personal

[A] Health Monitoring Earplug
- Monitoring Core Temperature
  Heart Pulse
  Dissolved Oxygen

[B] Fireman RFID Tag
- Bluetooth connections to Central Monitoring Unit (CMU)
- CMU will be able to pick up Fireman's ID through the RFID Tag attached to the fireman

[C] Temperature Sensing Gloves
- CMU will collect:
  (1) Signals picked-up from Earplug
  (2) Location Information
  (3) Signals from other sensors:
     a) sensor for outside temperature
     b) In-suits temperature sensor
     c) toxic gas detection sensor on uniform (oxygen, CO_2, SO_2, NO_2, etc.)
     d) oxygen content from BA unit.

[D] Ultra Small Rugged Phone for CMU
(Battery sustains 3-days after re-charged)
- CMU will "speak" to the Fireman via earplug, for data collection, using Fireman's selected language.

[E] Fire Cam
- Can transmit live video from Fire Scene

There are 5 types of Radio Signals to be maintained by the CMU:
(1) RFID for Fireman ID detection
(2) Bluetooth for all sensor connections
(3) Zigbee mesh for Squad communication
(4) 4G/5G communication for connection to outside Fire Scene
(5) Wi-Fi for possible temporary radio setup from the perimeters

All sensors will communicate with the CMU using Body Area Network (BAN) protocol.

Different signals will have its own ID in the protocol. (similar to equipment parameters pick-up using SNMP protocol in servers)

The CMU will provide the first level support for risk alert to Fireman, using voice-over-earplug.

In case of any vital sign exceeding the pre-set threshold, the CMU will send voice alert to:
- the Fireman carrying these equipment.
- the Squad via the Squad Mesh Network (SMN), and
- the Perimeter Monitoring Team (PMT) outside the Fire Scene.

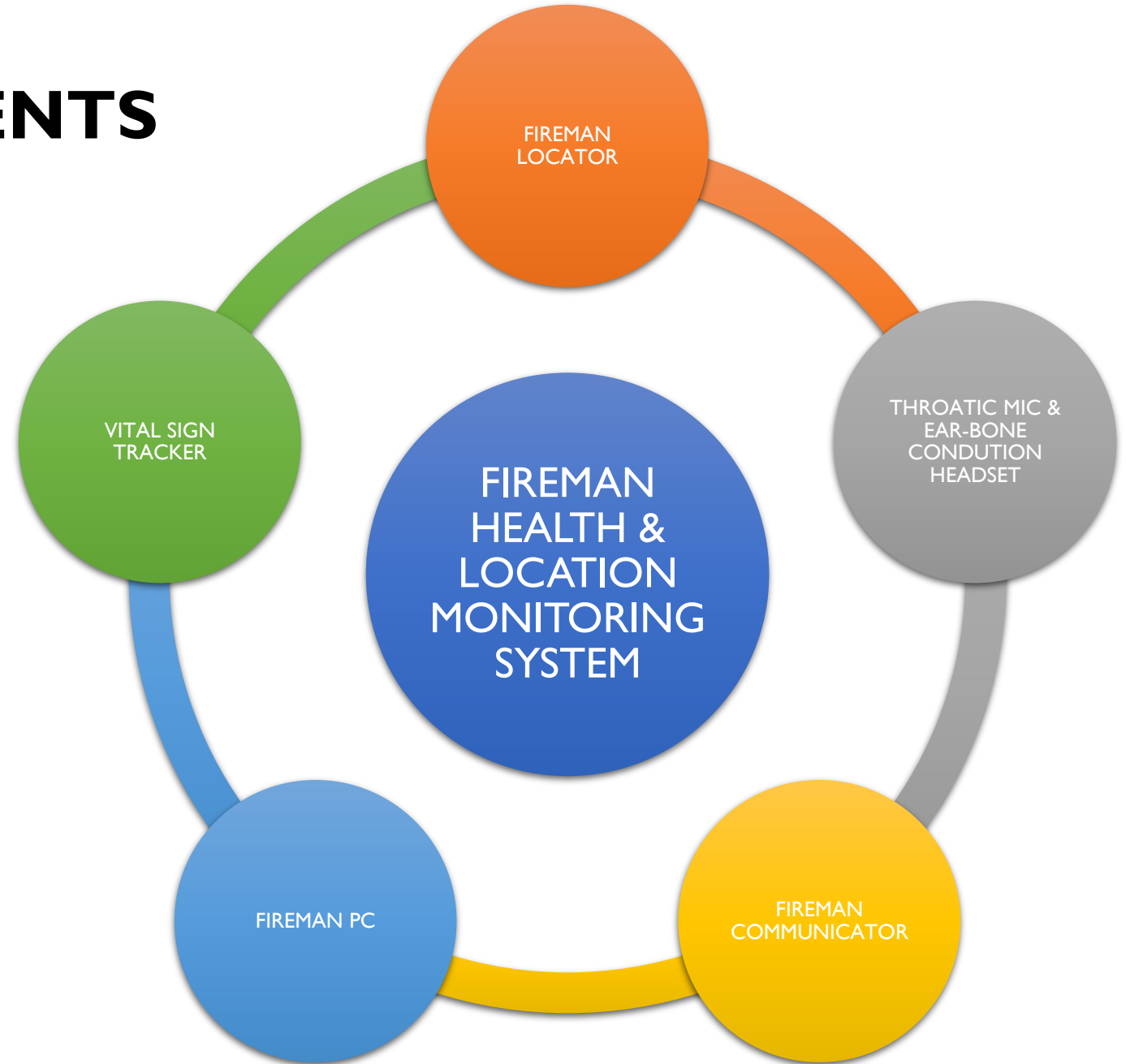Wishlist from EMSD InnoPortal

CUSTOMER REQUIREMENTS
FIREMAN'S HEALTH & LOCATION TRACKING SYSTEM

1. Real-time monitoring of heart-rate, core temperature & oxygen level
2. Real-time monitoring reporting Fireman's abnormality to affected Fireman and the remaining Squad nearby
3. Real-time location tracking of all Fireman's in the incident ground
4. Real-time alert to standby rescue team for reinforcement
5. The system shall identify the ID of the Fireman, the health environment data by IOT sensors in the fire-fighter's suit.
6. No hardwire for sensors – a body-based network shall pick up all ID's, health & sensor data
7. Sensor data shall be adaptive, with fire-fighting suit.
   1. It will measure outside temperature, in suit temperature, humidity, etc.
   2. With diving suit, it will measure depth, air volume remaining, etc.
8. Synthesize voice alert to squads in the incident ground through ear plug
9. An incident ground Squad mesh network for IOT sensor data and alert messages among all fire ground parties.
10. The strength of this mesh network shall be enhanced with more members present in the scene.
11. The whole solution shall be an integrated solution.
12. Connecting the Squad mesh network with an incident ground communication network.
13. Connecting Knowledge Management Portal with voice-based search function for expert opinions in such an emergency.

Wishlist from EMSD InnoPortal

COMMENT ON FEASIBILITY

CUSTOMER REQUIREMENTS	OUR COMMENTS
An ear-plug type health monitor to measure heart rate, core temperature, dissolved oxygen, etc	Not recommended. We suggest: • A headset with bone conduction speaker, throat mic and forehead temperature monitor • Use an BLE hand band for heart rate monitor
Measure temperature in fire-fighting suite and outside.	In suite feasible. Outside feasible but depends on more detail requirements.
Data to voice synthesizer to alert Fireman of health data	Feasible
Fireman tracking tools to send location to standby rescue team and nearby Squad through voice	Feasible
Software to capture Fire-fighting ground data and display on console map of standby rescue team	Feasible
Fireman RFID tag & sensors for different environment data to be fitted into the fire fighter's suit	Feasible for most occasion. Not possible under water.
Development Body Area network protocol to collect wearable IOT data.	Feasible
Further development on Body Area Network to adapted to different fireman's operation suits.	Feasible for most occasion. Not possible for under water.
Voice based Chatbot with Natural Language Processor (NLP) trained to Fire-fighter's language	Feasible
Development of wearable radio device – Central Monitoring Unit (CMU) to collect and send data to the incident ground Squad mesh network	Feasible
Development of an incident ground Squad mesh network with Zigbee inside the fire ground	Feasible but not advised. There would be better implementation.
Above components shall integrated into an overall system.	Feasible
CMU shall associate with another incident ground perimeter	Feasible
A Cloud based Knowledge Management Portal with SIRI like searching function for providing expert opinions to Fire-fighter in emergency	Feasible

SYSTEM COMPONENTS
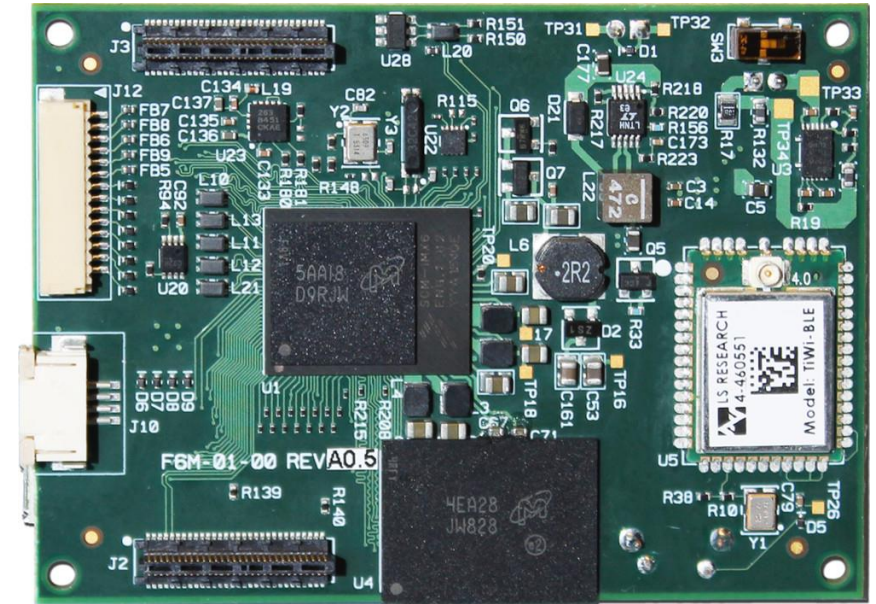
FIRMAN COMMUNICATOR

- An industrial grade digital land mobile radio with BLE built-in.

- Land mobile radio
  - Communicate with outside for voice and data
  - Can upgrade with development to support mesh-network that vastly further improve system reliability

- BLE radio
  - Talk to Android Board and get data from there to send to outside

- May consider include the Fireman PC into this radio

Just for reference

FIREMAN PC WITH BLE

- A small Industrial grade Android Board provide the computing core support all intelligent function:
    - Be the master to poll each device for vital data:
        - Body heart rate & oxygen level - update every 5s
        - Temperature sensors at multiple location - update every 3s
        - Location - update every 2s
    - Handle voice processing & generation
        - Generate voice prompt
        - For handsfree call routing/dialing
        - There are many voice processing software that can be implemented for the application
    - It communicate as follows:
        - Packet all data and communicate through Personal Communication Centre to outside Control Centre
        - Broadcast above data on regular basis to local team via BLE
- Can be combined with Personal Communication Centre as a single device.

Just for reference
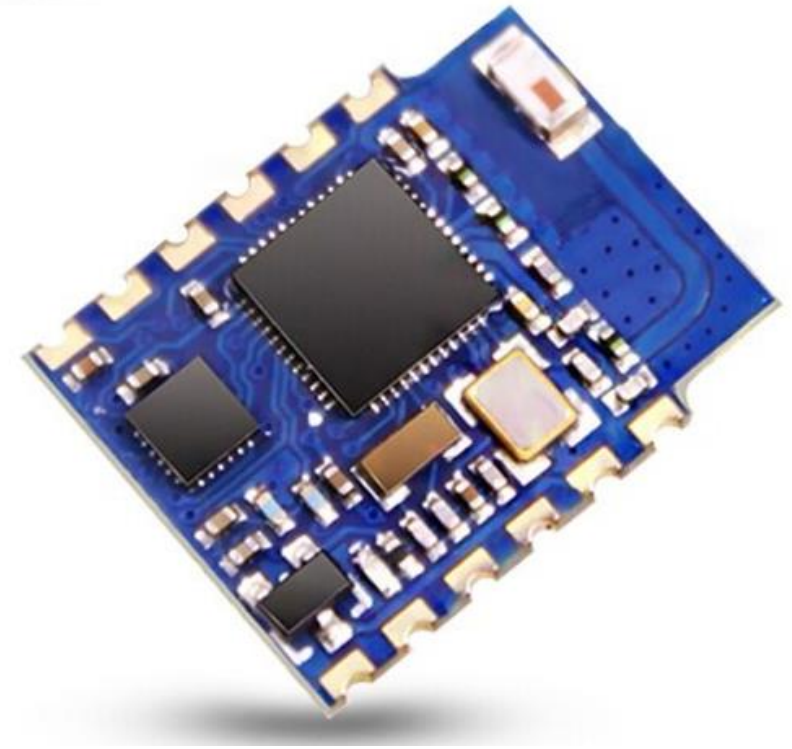
THROTIC MIC/ BONE CONDUCTION HEADSET

- Enable communication without blocking direct ear hearing.

- Either run on wire connection or via BLE to personal communication center.

Just for reference

FIREMAN LOCATOR WITH BLE

- Precision gyro/accelerometer based, AI compensated, location tracking module
  - About 2m position variation after a walking distance of 1km (+/- 0.2%)
  - Provide 3D co-ordinates (including altitude)
  - Can be correlated to map for further precision enhancement.
  - With BLE to communicate with FIREMAN PC
  - Install in the shoes.

Just for reference

VITAL SIGN TRACKERS

Vital sign tracking wrist band with BLE

- FDA approved SpO2 and pulse rate measurement

- Clinical grade accuracy

- Bluetooth Low Energy connection to gateway provides good indication of individual state.

- IP68 waterproof for reliable operation

Other sensors

- We can integrate other sensor, or even develop such as required into the system.

- Our key strength is the over-the-air protocol development – which is the key to integration.

Just for reference

OUR TEAM

- EDWIN CHEUNG
  - PhD, MAE, CUHK
  - Project Manager, ASTRI/LSCM
  - Project Director, O-Matic Intelligent Robot Limited

- FRANCIS TAI
  - MSc, HKUST
  - Founder, HKRFID, RFID & system integration service expert

- WILLIAM FU
  - BBA and MTM, IT Management, HKUST
  - Director and Co-Founder, Power Tech
  - Co-Founder, ZYNE, R&D in collaborate with HKU researchers for IoT and indoor location-based technology

- ROMEO YIP
  - MSc EE, HKUST
  - CTO, On Real International, world major ODM supplier of digital walkie talkie.
  - Program Manager, Perception Digital Limited

- ALFRED SHIU
  - B. Soc. Sci, HKU
  - Director, Vocentrix Technology Limited, develop & manufacture wireless audio and video transmission products for US/Japan companies.
  - Consultant, On Real International developing wireless products